UNIVERSITI PUTRA MALAYSIA

FACTORS AFFECTING BROWNING OF SAGO (METROXYLON SAGU ROTTB.) PITH AND THEIR EFFECTS ON SAGO STARCH

SHIRLENE MARIA ANTHONYSAMY

FSMB 2002 16

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By

SHIRLENE MARIA ANTHONYSAMY

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfillment of Requirement for the Degree of Master of Science

October 2002

Dedication

Specially dedicated to my late father, S. Anthonysamy

and

To my beloved mother Elizabeth Thevasagayam

.....You are just beyond comparison.

You have made me what I am today.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirements for the degree of Master of Science

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Chairman : Assoc. Prof. Dr. Nazamid Saari

Faculty : Food Science and Biotechnology

The effect of four parameters on the browning of sago pith was evaluated i.e. maturity of the sago palm, and holding time, pH and temperature of the sago pith slurry. The effect of sago palm maturity on the browning of sago pith was determined using sago pith slurries from three maturity stages i.e. young, premature and mature. The sago palms were sectioned into top and bottom to examine the effect of trunk growth on the concentrations of soluble phenolic compounds. Two soluble phenolic compounds were found to be present in the sago pith i.e. (+)-catechin and (-)-epicatechin. Concentrations of (+)-catechin and (-)-epicatechin were higher in mature sago palms while distribution of these compounds with trunk gowth did not show a clear correlation. Soluble polyphenol oxidase (SPPO) activity increased while latent polyphenol oxidase (LPPO) activity decreased with increase in maturity of the sago palms. Colour development in the slurry monitored in terms of lightness (L) and redness (a) using the HunterLab Ultrascan Spectrocolorimeter was more intense (darker and redder) in mature sago palms.

The effect of holding time, pH and temperature of the sago pith slurry was studied using a mature sago palm. Browning was evaluated based on concentrations of (+)-catechin and (-)-epicatechin and colour development in the sago pith slurry. The effect of holding time (duration for which sago pith slurries were held) on the browning of sago pith slurry was studied for 1, 6, 12 and 24 hours. An increase in holding time resulted in significant ($P<0.05$) decreases of (+)-catechin and (-)-epicatechin. Colour development in the slurry was significantly ($P<0.05$) more intense with increased holding time but was not significant ($P<0.05$) after six hours. The effect of pH on the browning of sago pith was studied using sago pith slurries with pH from 3.5 to 7.0 with a holding time of 24 hours. Concentrations of (+)-catechin and (-)-epicatechin decreased significantly ($P<0.05$) with an increase in pH particularly between pH 5.0 and 6.5 which resulted in significant ($P<0.05$) colour development. The effect of temperature on the browning of sago pith was investigated using sago pith slurries with temperatures from 10°C to 50°C with a holding time of 24 hours. The amount of (+)-catechin and (-)-epicatechin decreased significantly ($P<0.05$) with the increase in temperature while colour development increased significantly ($P<0.05$) with temperatures particularly above 40°C.

The quality of sago starch extracted from slurries with different pH and temperatures and held for 24 hours was determined. Starch quality was determined in terms of colour development, granule morphology and pasting profile. Significant ($P<0.05$) colour development was noted in starches extracted from slurries of different pH and temperatures though they were washed twice during extraction. Granule morphology of the starches was observed using the Scanning Electron Microscope. Starches from slurries of strong acidic (pH 3.5 to 4.5) conditions exhibited fissures on the surface of granules while those from weaker acidic (pH 5.0 to 7.0) conditions had

minor protrusions. Starches from slurries at different temperatures had only minor modifications on the surface of the granules. The pasting profile of the starches was examined using the Brabender Viskograph. Starches from strong acidic conditions showed lower viscosities while starches from high temperatures (30°C to 50°C) were not greatly affected.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi syarat ijazah Master Sains

FAKTOR YANG MEMPENGARUHI PEMERANGAN DALAM SLURI SAGU (*METROXYLON SAGU* ROTTB.) DAN KESANNYA TERHADAP KANJI SAGU

Oleh

SHIRLENE MARIA ANTHONYSAMY

Oktober 2002

Pengerusi : Prof. Madya Dr. Nazamid Saari

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Empat parameter utama pemerangan dalam sagu telah dikaji iaitu kematangan batang sagu, dan jangka masa penyimpanan, pH serta suhu sluri sagu. Kesan kematangan batang sagu terhadap pemerangan sagu dilakukan dengan menggunakan sluri sagu dari tiga peringkat kematangan iaitu muda, pramatang dan matang. Pokok sagu dibahagikan mengikut bahagian atas dan bawah untuk mengkaji kesan pertumbuhan batang sagu terhadap kepekatan bahan fenolik terlarut. Dua bahan fenolik terlarut didapati hadir dalam sagu iaitu (+)-katekin dan (-)-epikatekin. Kepekatan (+)-katekin dan (-)-epikatekin didapati lebih tinggi dalam pokok sagu yang matang sementara taburan bahan ini dengan pertumbuhan batang sagu tidak menunjukkan korelasi yang nyata. Aktiviti enzim polifenol oksida terlarut meningkat manakala aktiviti enzim polifenol oksida tidak terlarut menurun dengan meningkatnya kematangan batang sagu. Perkembangan warna sluri sagu yang diukur berdasarkan keterangan (L) dan kemerahan (a) dengan menggunakan HunterLab Scan menunjukkan bahawa batang sagu yang matang menghasilkan warna yang lebih ketara (lebih gelap dan merah).

Kesan jangka masa penyimpanan, pH dan suhu sluri sagu dikaji dengan menggunakan batang sagu yang matang. Pemerangan dikaji berdasarkan kepekatan (+)-katekin dan (-)-epikatekin serta kewujudan warna. Kesan jangka masa penyimpanan (tempoh sluri sagu disimpan) terhadap pemerangan sagu diperhatikan untuk 1, 6, 12 dan 24 jam. Peningkatan jangka masa pemerangan menyebabkan penurunan dalam kepekatan bahan fenolik secara signifikan ($P<0.05$). Kewujudan warna lebih ketara secara signifikan ($P<0.05$) dengan meningkatnya jangka masa pemerangan tetapi tidak signifikan ($P<0.05$) selepas enam jam. Kesan pH terhadap pemerangan sluri sagu dikaji dengan menggunakan sluri sagu pada pH antara 3.5 hingga 7.0 serta jangka masa pemerangan selama 24 jam. Kepekatan (+)-katekin dan (-)-epikatekin menurun secara signifikan ($P<0.05$) dengan meningkatnya pH terutamanya antara pH 5.0 dan 6.5 yang menyebabkan kewujudan warna sluri sagu yang signifikan ($P<0.05$). Kesan suhu terhadap pemerangan sluri sagu diperhatikan dengan menggunakan sluri sagu pada suhu antara 10°C hingga 50°C serta jangka masa pemerangan selama 24 jam. Amaun (+)-katekin dan (-)-epikatekin menurun secara signifkan ($P<0.05$) dengan meningkatnya suhu sementara kewujudan warna sluri meningkat secara signifikan ($P<0.05$) dengan meningkatnya suhu terutamanya pada suhu melebihi 40°C.

Kualiti kanji sagu yang diekstrak daripada sluri yang berlainan pH dan suhu serta jangka masa penyimpanan selama 24 jam dikaji. Kualiti kanji sagu ditentukan dari segi kewujudan warna, morfologi granul dan profil pemasakan. Kewujudan warna yang signifikan ($P<0.05$) dikesan pada kanji sagu yang diekstrak daripada sluri yang berlainan pH dan suhu walaupun telah dibasuh sebanyak dua kali semasa pengekstrakan. Morfologi granul kanji sagu diteliti menggunakan *Scanning Electron*

Microscope. Granul kanji sagu daripada sluri dengan pH asid kuat (pH 3.5 hingga 4.5) mempunyai kesan rekahan pada permukaannya manakala granul sagu dari sluri dengan pH asid lemah (pH 5.0 hingga 7.0) hanya mempunyai sedikit bonjolan. Kanji sagu daripada sluri pada suhu berlainan hanya menunjukkan sedikit modifikasi pada permukaan granul. Profil pemasakan kanji ditentukan dengan menggunakan *Brabender Viskograph*. Kanji sagu daripada sluri dengan pH asid kuat mempunyai viskositi yang lebih rendah manakala kanji sagu daripada sluri dengan suhu lebih tinggi (30°C hingga 50°C) pula tidak banyak berubah.

ACKNOWLEDGEMENTS

Writing up a research thesis is no easy task. It is made more stressful when you do not have the right people around you. Among the many souls that have helped me along the way, my foremost gratitude goes to my Project Supervisor Assoc. Prof. Dr Nazamid Saari. He has been very very patient with me despite my shortcomings. His encouragement and valuable advice has been my motivation all the while. Special appreciation must also be extended to Assoc. Prof. Dr Sharifah Kharidah Muhammad who has been really generous with her time and guidance. Not forgetting my other co-supervisors Dr Fatimah Abu Bakar for her kind assistance and motivation and Assoc. Prof. Dr Radzali Muse for his fruitful opinions and invaluable time. I would also like extend my recognition to Professor Dr Hasanah Mohd Ghazali who has been gracious with her time and advice in assessing my thesis.

For all those staff of FSMB who have helped me during the course of my research: Mr Chan, Kak Jam, Encik Azman, Encik Halim, Kak Rauna, Kak Siti, Kak Husaini; words are not enough to thank you for the help you have given me. My labmates Yetty, Galila, Kala, Mei Chee and Mahanum Mahmud; thank you for your companionship and help, life would have been millions of minutes slower without you around. My mom, my mentor, as always, thank you so much for putting up with me. Not forgetting my sister; Selvi Margaret, my brothers; Justin Joseph, Isaac Stephen and my in-laws. Thank you for your support, your encouragement, your prayers and your love that kept me going and still is. Lastly, to the one above, your mysterious ways of answering prayers is always an amazement. Nothing would have been possible without you!

I certify that an Examination Committee met on 28th October 2002 to conduct the final examination of Shirlene Maria Anthonysamy on her Master of Science thesis entitled "Factors Affecting Browning of Sago (*Metroxylon sagu* Rottb.) Pith and Their Effects on Sago Starch" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations, which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

SHIRLENE MARIA ANTHONYSAMY

Date: 27/11/2002

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Absorbance Unit	AU
Brabender Unit	BU
Carbon eighteen	C_{18}
Carbon six	C_6
Carbon three	C_3
High Performance Liquid Chromatography	HPLC
Kilogram	kg
Latent Polyphenol Oxidase	LPPO
Mature Bottom	MB
Mature Top	MT
Microgram	µg
Microgram per millilitre	µg/L
Microlitre	µL
Micrometre	µm
Milli molar	mM
Millilitre	ml
Millimetre	mm
Milllitre per minute	ml/min
Minutes	min
Molar	M
Nanometre	nm
Normality	N
Polyphenol oxidase	PPO

Premature Bottom	PMB
Premature Top	PMT
Relative centrifugal force unit	RCF
Retention time	R_T
Scanning Electron Microscope	SEM
Soluble Polyphenol Oxidase	SPPO
Ultraviolet	UV
Volume per volume	v/v
Weight per volume	w/v
Young Bottom	YB
Young Top	YT